

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Group Art Unit: 2811

Examiner: Thien F. Tran

Serial No.: 10/625,490

Filed: July 22, 2003

In re Application of: Issaq et al.

For: SWITCHING RATIO AND ON-STATE RESISTANCE OF AN ANTIFUSE
PROGRAMMED BELOW 5 MA AND HAVING A TA OR TAN BARRIER
METAL LAYER

AMENDMENT

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

In response to the Office Action dated May 18, 2007, kindly amend the above-identified application as follows.

Amendments to the claims begin on page 2

Remarks begin on page 5.

In the claims:

1-10. (Cancelled)

11. (Currently Amended) A metal-to-metal antifuse disposed between two metal interconnect layers in an integrated circuit comprising:

a tungsten plug disposed in a via in an insulating layer disposed above and in electrical contact with a lower metal interconnect layer;

~~a first layer of a barrier metal disposed above and in electrical contact with said tungsten plug forming a first electrode, said first layer of said barrier metal comprising a material selected from a group consisting of at least one of tantalum and tantalum nitride;~~

an antifuse layer disposed above an upper surface of said tungsten plug, said antifuse layer comprising a lower adhesion-promoting layer, a middle layer comprising amorphous carbon, and an upper adhesion-promoting layer;

a layer of a barrier metal disposed over said antifuse layer forming a second electrode, said layer of said barrier metal comprising a material selected from a group consisting of at least one of tantalum and tantalum nitride; and

a second insulating layer disposed over said ~~first~~ insulating layer, said antifuse layer, ~~said first layer of said barrier metal~~, and said ~~second~~ layer of said barrier metal.

12. (Original) The metal-to-metal antifuse of Claim 11, wherein said layer of amorphous carbon is doped with at least one of hydrogen, fluorine, and hydrogen and fluorine.

13. (Canceled)

14. (Original) The metal-to-metal antifuse of Claim 11, wherein said antifuse layer is about 10 nm to about 80 nm in thickness.

15. (Previously Presented) The metal-to-metal antifuse of Claim 11, wherein said layer of said barrier metal layer is about 25 nm to about 200 nm in thickness.

16. (Previously Presented) The metal-to-metal antifuse of Claim 11, wherein said lower adhesion-promoting layer comprises amorphous silicon carbide, said middle layer comprises amorphous carbon, and said upper adhesion-promoting layer comprises amorphous silicon carbide.

17. (Previously Presented) The metal-to-metal antifuse of Claim 11, wherein said lower adhesion-promoting layer comprises amorphous silicon nitride, said middle layer comprises amorphous carbon, and said upper adhesion-promoting layer comprises amorphous silicon nitride.

18. (Currently Amended) The metal-to-metal antifuse of Claim 11, further comprising an oxide layer disposed on said ~~second~~ layer of said barrier metal layer.

19. (Original) The metal-to-metal antifuse of Claim 11, further comprising a tungsten layer disposed on said second layer of said barrier metal layer.

20-52. (Canceled)

REMARKS

Claims 11-12 and 14-19 are presently pending in the above-identified patent application.

No claim is allowed.

Claims 11-12 and 14-19 have been rejected pursuant to 35 U.S.C. §112, first paragraph, as failing to comply with the written description requirement. It is respectfully submitted that this rejection is improper, since the claimed subject matter is in fact described in the specification and drawings, albeit not the drawing figure referred to by the examiner. Because the claimed subject matter is in fact described in the specification and drawings, any rejection under the first paragraph of §112 is improper. In view of the amendments to the claims, this rejection is believed to be moot in any event.

Claims 11-12 and 14-19 have been rejected pursuant to 35 U.S.C. §112, second paragraph, as failing to particularly point out and distinctly claim the subject matter regarded as the invention. Several reasons for this rejection were given by the examiner.

Claim 11 has been amended to remove reference to a first layer of a barrier metal.

Claim 11 has been amended to change the recitation of “said first insulating layer” on line 15 to “said insulating layer” to provide agreement with the antecedent on line 3.

Claim 11 has also been amended at line 16 to refer to “said layer of said barrier metal.”

Claims 18 and 19 have been amended at line 2 to refer to “said layer of said barrier metal.”

Withdrawal of the rejections under §112, second paragraph is respectfully requested.

Claims 11, 12, 14, 15, and 17-18 have been rejected pursuant to 35 U.S.C. §103(a) as unpatentably obvious over Hawley, in view of Jain et al. and further in view of Gangopadhyay. Claim 19 has been rejected pursuant to 35 U.S.C. §103(a) as unpatentably obvious over Hawley, in view of Jain et al. and further in view of Gangopadhyay, and further in view of Forouhi.

The examiner has basically repeated the same arguments as set forth in prior rejections. Significantly, the examiner has completely failed to consider or even address the unexpected markedly different and superior characteristics of the claimed antifuse. This failure is clear from the examiner’s comment that “Applicant’s argument cannot take the place of evidence in the record.” This comment clearly establishes that the examiner has failed to consider the graphs in FIGS. 11 through 13 and the accompanying text in the specification at paragraphs [0083] through [0087]. This evidence is in the specification itself and is thus undeniably in the record. This evidence was pointed out to the examiner at page 6 of the Amendment filed on April 19, 2007 in response to the Office Action mailed on January 8, 2007.

It is plain that the examiner did not consider this evidence since he completely failed to mention it or refute in the next Office Action mailed on May 18, 2007. The examiner merely stated "Applicant has not provided convincing scientific evidence to support his contention that the structure of the combined teachings of the prior art does not possess the same characteristics relied on." This statement makes no sense since "the structure of the combined teachings of the prior art" is in fact the present invention reconstructed from the fragments of three different prior art references, no one of which has the characteristics of the invention. The examiner's statement thus essentially makes the nonsensical point that the applicant must prove that his own invention (reconstructed using hindsight gathering of elements handpicked from among different references with the invention in mind) does not have the same characteristics as his invention as claimed. This is not now and has never been the law. The law states that the applicant can prove non-obviousness by proving that the result of combining the various elements as claimed has unexpected markedly different and superior characteristics than would be predicted from the prior art.

Paragraph [0086] of the specification states:

When compared to the antifuse of FIG. 11, an antifuse having a Ta or TiN barrier metal layer with an amorphous carbon antifuse layer exhibits a decrease in resistance by about one order of magnitude at a programming current of about 0.5mA. Thus, the resistance decreases below 200 ohms or a magnitude of 10."

If the examiner believes that the graphs in FIGS. 11 through 13 and the accompanying text in the specification at paragraphs [0083] through [0087] is not sufficient scientific evidence, it is the examiner's burden to state why this is so. The examiner has completely failed to do this and in fact has completely failed to acknowledge that this argument was even made.

The specification states that the graphs are the results of a resistance test of antifuse resistance. It certainly appears that a resistance test is exactly the kind of "scientific evidence" that may be relied upon to show non-obviousness. It is respectfully submitted that, as shown in the graphs, a reduction in resistance over the prior art of an order of magnitude is scientific evidence of "unexpected markedly different and superior characteristics" and thus unobviousness. The examiner is challenged to specifically refute the proposition that a difference of an order of magnitude drop in programmed resistance over the prior art is not conclusive evidence of non-obviousness.

Finally, the examiner has completely failed to consider the statements in paragraph 4 of the Declaration of Frank Hawley, already of record in this case. These statements demonstrate additional unexpected results relating to the dramatically lower (five to twenty-five times lower than the prior art) programming currents used by the antifuses of the present invention.

It is respectfully requested that the examiner respond to each of these individual instances of unexpected results and either explain why they are not “scientific evidence” or why the dramatic differences in behavior and performance of antifuses according to the present invention and antifuses in the prior art do not amount to evidence of non-obviousness. The examiner is asked to specifically address why a decrease in resistance over the prior art of an order of magnitude and a decrease in programming current over the prior art of between five and twenty-five times is other than an unobvious result.

Applicants believe that the above application is now in condition for allowance, and such action is respectfully requested.

If the Examiner has any questions regarding this application or this response, the Examiner is requested to telephone the undersigned at 775-586-9500.

Respectfully submitted,
SIERRA PATENT GROUP, LTD.

Dated: November 15, 2007

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